



UNIONE EUROPEA
Fondo Sociale Europeo



Borsa di dottorato aggiuntiva del Programma Operativo Nazionale Ricerca e Innovazione 2014-2020 (CCI 2014IT16M2OP005), Fondo Sociale Europeo, Azione I.1 "Dottorati Innovativi con caratterizzazione Industriale"

New Materials and Processes for the Removal of Pollutants from Aqueous Matrices

Codice Borsa : DOT1312707

CUP :F81I17000230007

Corso di Dottorato di Ricerca in Ingegneria dei Materiali e delle Strutture e Nanotecnologie – XXXVI Ciclo

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The topic of the research project concerns the study of advanced wastewater treatments aimed at their drinking, environmental and agricultural reuse. Currently, the problem of potable reuse (direct and indirect) attract great attention due to the shortage of natural drink water resources, irrational use, and the increasing degradation by human activities. So, this limited availability of drinking water with sufficient qualities leads to saving our natural resources by recycling the used water. Also, it is crucial to be sure that the reused water is totally safe for humans and the environment. Based on the potential concern for public health, it is preferable to limit the release of potentially toxic compounds into the environment. Therefore, the additional treatments need to be systematically taken into consideration the elimination of organic micropollutants before release into the receiving waters.

Based on this project, the research activity will focus on studying the elimination of organic micropollutants with the integration of advanced oxidation processes (AOPs) and applied on wastewater coming out of secondary biological purification treatments. In particular, we intend to compare the different AOPs performances using O_3 , H_2O_2 , UV, Catalyst, and Photocatalyst and investigate different process configurations. Also, the applied UV fluence and the hydroxyl radical exposure during laboratory- and pilot-scale UV-based AOPs treatment would be determined by modeling abatement of micropollutants acting as internal probe compounds. The experimentation will be carried out mainly in the pilot plant of the AquaSoil company by using the innovative MITO₃X® technology, which allows the simultaneous injection of liquids, gases, and solids, ensuring high mixing rates. Also, some experiments will be implemented in parallel with the Chemistry Laboratories in the Department of Innovation Engineering of the University of Salento and the Department of Chemical and Biochemical Engineering of the Western University.

Based on the experimental observations, models will be developed to fully interpret the mechanisms involved in the various stages of the process, identify all the variables, and optimize the parameters according to their achieved efficiencies.



AquaSoil SrL is a company that designs and manages integrated services in the environmental field, specializing in the refining and distribution of urban wastewater for agricultural and environmental reuse.

Many years of experience in the field of monitoring and modeling of the environmental effects deriving from reuse activities (for example, the qualitative-quantitative analysis of the transport and diffusion dynamics of anthropogenic and natural pollutants in the aquifer and the soil) makes AquaSoil the contractor for the management service of the urban wastewater refining plant in Fasano Forcatella.

The refining system is equipped with advanced tertiary treatment technologies developed by the same manager and in continuous evolution thanks to the numerous experimentation and research activities that are still in progress. The achieved experience related to managing the plant, together with the participation in multiple national and international research initiatives, has allowed the company to develop specialized skills in the management of the ordinary and extraordinary phases of processes and refinement technologies, and in particular in the development and management of advanced purification processes capable of removing anomalous polluting loads from the effluent.



Western University (www.uwo.ca) is one of the significant Canadian universities in London, Ontario.

The Faculty of Engineering hosts four departments (Civil and Environmental Engineering, Electrical and Computer Engineering, Chemical and Biochemical Engineering, Mechanical and Materials Engineering) internationally known for the research's production and impact. In particular, the Department of Chemical and Biochemical Engineering possesses professional experts in the field of reactor engineering, environmental catalysis, and applied biochemistry. The activities, coordinated by professors and researchers with an international profile, accomplish within advanced structures equipped with state-of-the-art equipment and qualified support staff.